



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : E21B 43/10	A1	(11) International Publication Number: WO 00/50732 (43) International Publication Date: 31 August 2000 (31.08.00)
(21) International Application Number: PCT/US00/04683 (22) International Filing Date: 24 February 2000 (24.02.00) (30) Priority Data: 60/121,452 24 February 1999 (24.02.99) US (71) Applicant: SHELL OIL COMPANY (US/US); 900 Louisiana, P.O. Box 2463, Houston, TX 77252-2463 (US). (72) Inventors: NAZZAI, Gregory, Richard; 3918 Laurel Rock Drive, Kingwood, TX 77345 (US). FRANK, Timothy, John; 16211 Hickory Point Road, Houston, TX 77095 (US). COON, Robert, Joe; 4603 Misty Hollow Drive, Missouri City, TX 77459 (US). (74) Agent: STEINBERG, Beverlee, G.; Shell Oil Company, 900 Louisiana, P.O. Box 2463, Houston, TX 77252-2463 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: SELECTIVE ZONAL ISOLATION WITHIN A SLOTTED LINER (57) Abstract Selective isolation of a zone within a slotted liner completion of a wellbore is accomplished by expanding the original slotted liner to the full inner diameter of the wellbore into the annular area normally found around slotted liners. At least one solid tubular is run into the expanded area of the slotted liner and expanded at least in that section of the wellbore to be isolated. A custom expandable slotted liner can be run and expanded within the existing expanded slotted liner if excessive splits or rips should occur in the existing slotted liner due to expansion. Epoxies, rubber, or other sealing materials can also be utilized to better effect a seal between the liners.		

BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LJ	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

DESCRIPTIONSELECTIVE ZONAL ISOLATION WITHIN A SLOTTED LINERTechnical Field

The present invention relates to a method to provide isolation within a zone of a wellbore lined with a slotted liner by placing an expandable liner within the zone to be isolated.

5 Background Art

There is a great deal of prior art relating to isolating portions of a wellbore for various reason. For example, a zone may be producing water or gas and needs to be shut off for more effective production of the petroleum being recovered. Also,
10 a zone may be producing sand or collapsing and creating debris and needs to be isolated to maintain an efficient operation. However, different problems arise when the wellbore has been completed with the insertion of a known slotted liner.

One example of the prior art is U.S. Pat. No. 5,366,012
15 which describes a method of completing uncased sections of a wellbore by placing, at a predetermined position in the wellbore, a liner which is provided with a plurality of overlapping slots. The upper end of the liner is fixed in place and an upwardly tapering expansion mandrel is drawn upwardly through the slotted
20 liner expanding it outwardly to engage the walls of the wellbore. This circumferentially outward movement is facilitated by the opening of the slots, together with a slight shortening of the overall length of the liner. Slotted liner completions of this type leave an annular area around the slotted liner which makes
25 zonal selectivity nearly impossible.

Another suitable method for sealing between a lining and wellbore, casing or pipeline is shown in U.S. Pat. No. 5,494,106. This patent describes a deformable annular seal which

is lowered into the wellbore in a deformed or contracted state, which does not impede insertion. Once in place the seal is expanded. During expansion of the seal it is hardened to form a substantially permanent repair.

5 Another method for lining a casing is shown in U.S. Pat. No. 5,454,419 in which a tubular polymeric material is lowered into the wellbore in a stretched condition, due to a series of weights attached to the leading or bottom end. When properly positioned, the weights are released and the tubular
10 material returns to its normal condition in which it presses against the walls to the wellbore.

Disclosure of the Invention

The present invention provides a method to provide selective isolation within a zone of a well lined with an
15 expanded slotted liner, comprising the steps of:

fully expanding said expanded slotted liner within the wellbore to contact substantially the entire surface of the wellbore adjacent said liner;

placing at least one additional expandable
20 substantially imperforate liner within a zone of the original expanded liner to be isolated; and

expanding said at least one additional expandable liner into sealing contact with the original expanded slotted liner at least adjacent the ends of the zone to be isolated whereby the
25 desired zone of the wellbore is isolated from the formation.

The selective zonal isolation system of the present invention can be utilized within a slotted liner completion to selectively isolate, either permanently or temporarily, sections of the wellbore for such applications as fluid shutoff or
30 stimulation purposes. The subject selective zonal isolation system works by first expanding an existing slotted liner in the wellbore to the full inner diameter of the hole. Then one or more

solid tubular members are run into the expanded area and are expanded at least in that section of the wellbore to be isolated.

It is also possible to use expandable packers to selectively isolate the section. Additionally, if excessive
5 splits or rips should occur in the existing slotted liner, after expansion, a custom second expandable slotted liner can be run into the wellbore and expanded within the original expanded slotted liner. Epoxies, rubber, or other sealing materials can also be utilized to better effect a seal. The same methodology
10 could also be utilized in solid uncemented pipe sections to increase the effective wellbore radius. Benefits are sealing or zonal isolation of existing slotted liner, perforated pipe, sand control device or open hole or other completion system.

Brief Description of the Drawings

15 The present invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a vertical section through a portion of a wellbore with an expandable liner in place;

Fig. 2 is a vertical section similar to Fig. 1 showing
20 the wellbore after expansion of the liner;

Fig. 3 is a vertical section of the same well with the secondary liner in position; and

Fig 4. Is a vertical section through the well of Fig. 3 with the sealing liner in place.

25 Detailed Description of a Preferred Embodiment

The wellbore 10 (Figs. 1 and 2) has a first expandable liner 12 in place and running through a zone of the wellbore to be isolated. Generally this first liner, when expanded, does not fully contact all surfaces of the wellbore and it can contain a
30 number of tares and/or rents in the slots. A second liner 14 (Figs. 3 and 4) is inserted into the wellbore and positioned to cover at least the zone of the wellbore 10 to be isolated. Then

the second liner 14 is expanded to sealing engage the first expanded slotted liner 12 sealing the openings therein to isolate that portion of the wellbore. This sealing can be improved by the addition of sealing materials (not shown), such as epoxies, rubber and the like.

While only a single second liner 14 has been shown, it is within the scope of the present invention to include insertion of more than one second liner. It is also within the scope of the invention that these second liners have physical characteristics different from one another so that, for example, a first liner would have characteristics suitable for withstanding high pressures while the next liner would have characteristics suitable for withstanding erosive effects of the flow through the wellbore.

It should be noted when any slotted liner is expanded, many things can happen to it since wellbores are never smooth cylinders. For example, while it is hoped that the majority of the slots will open as expected allowing the slotted liner to expand, the wellbore walls are never uniform and expansion will be at various rates in different directions and for different distances. This variation in expansion can stress the slotted liner producing tears, rents and other openings which, while not adversely affecting the task of the slotted liner, can result in problems for subsequently sealing portions of the wellbore protected by such a slotted liner.

The selective zonal isolation system of the present invention can be utilized within a slotted liner completion to selectively isolate, either permanently or temporarily, sections of the wellbore for such applications as fluid shutoff or stimulation purposes. Current slotted liner completions leave an annular area around the slotted liner which makes zonal selectivity nearly impossible. The selective zonal isolation

system according to the present invention works by first expanding the current slotted liner to the full inner diameter of the wellbore, running at least one solid tubular liner into the expanded area and expanding at least that section of the tubular liner in the area to be isolated. Additionally, if
5 excessive splits or rips should occur in the existing slotted liner after expansion, a custom expandable slotted liner (not shown) can be run into the wellbore and expanded within the existing expanded slotted liner. Epoxies, rubber, or other
10 sealing materials (also not shown) can also be utilized to better effect a seal between the expanded slotted liner and the tubular liner.

The same methodology of the present invention could also be utilized in solid uncemented pipe sections to increase
15 the effective wellbore radius.

While a metal tubular liner has been shown in the drawings, the liner is not so limited. The tubular liner could be made from a wide variety of metals and plastics materials. For example, a memory metal could be used. The tubular liner would
20 be formed on the surface, deformed for insertion into the wellbore, and reformed when in position. Likewise, the tubular liner could be formed and folded or compressed and later expanded or reformed when in position by use of a mechanical device such as a mandrel or an inflatable member, or by a hydro-pneumatic
25 force, including an explosive force.

Benefits of the present invention include sealing or zonal isolation of existing slotted liner, perforated pipe, sand control device or open hole or other completion system.

The present invention may be subject to many
30 modifications and changes which would occur to one skilled in the art. Thus, the described embodiment should be considered in all

respects as illustrative and not restrictive of the scope of the subject invention as defined by the accompanying claims.

CLAIMS

1. A method to provide selective isolation within a zone of a well lined with an expanded slotted liner, comprising the steps of:

5 fully expanding said expanded slotted liner within the wellbore to contact substantially the entire surface of the wellbore adjacent said liner;

placing at least one additional expandable substantially imperforate liner within a zone of the original
10 expanded liner to be isolated; and

expanding said at least one additional expandable liner into sealing contact with the original expanded slotted liner at least adjacent the ends of the zone to be isolated whereby the desired zone of the wellbore is isolated from the formation.

15 2. The method according to claim 1 wherein said sealing is permanent.

3. The method according to claim 1 or 2 wherein said at least one additional expandable liner is inserted in a compressed condition and released when in position, or is
20 inserted in a collapsed condition and expanded when in position.

4. The method according to any of claims 1-3 wherein said at least one additional expandable liner is formed of a memory retentive material which is initially formed, then deformed to allow insertion into the wellbore, and its memory
25 activated to expand the liner to its original shape and seal the selected zone of the wellbore.

5. The method according to any of claims 1-4 wherein said at least one expandable liner is formed from metal or a plastics material.

30 6. The method according to any of claims 1-5 wherein each said at least one expandable liner has different physical characteristics from a preceding liner whereby different

characteristics of flow through the wellbore, such as pressure and erosion, can be addressed.

7. The method according to any of claims 1-6 wherein said expansion is accomplished by use of a mandrel, an explosive
5 force, or pressurized fluid.

8. The method according to any of claims 1-7 further comprising the step of:

applying sealing materials to effect a better seal between said slotted liner and said at least one expandable
10 liner.

9. A selective zonal isolation system which can be utilized to selectively isolate, either permanently or temporarily, sections of a wellbore within a slotted liner completion for such applications as fluid shutoff or stimulation
15 purposes, comprising:

expanding the existing slotted liner to substantially that of the inner diameter of the wellbore;

running at least one expandable imperforate liner into the zone to be isolated; and

20 expanding said at least one liner to sealingly engage said slotted liner at least adjacent the ends of said zone to be isolated.

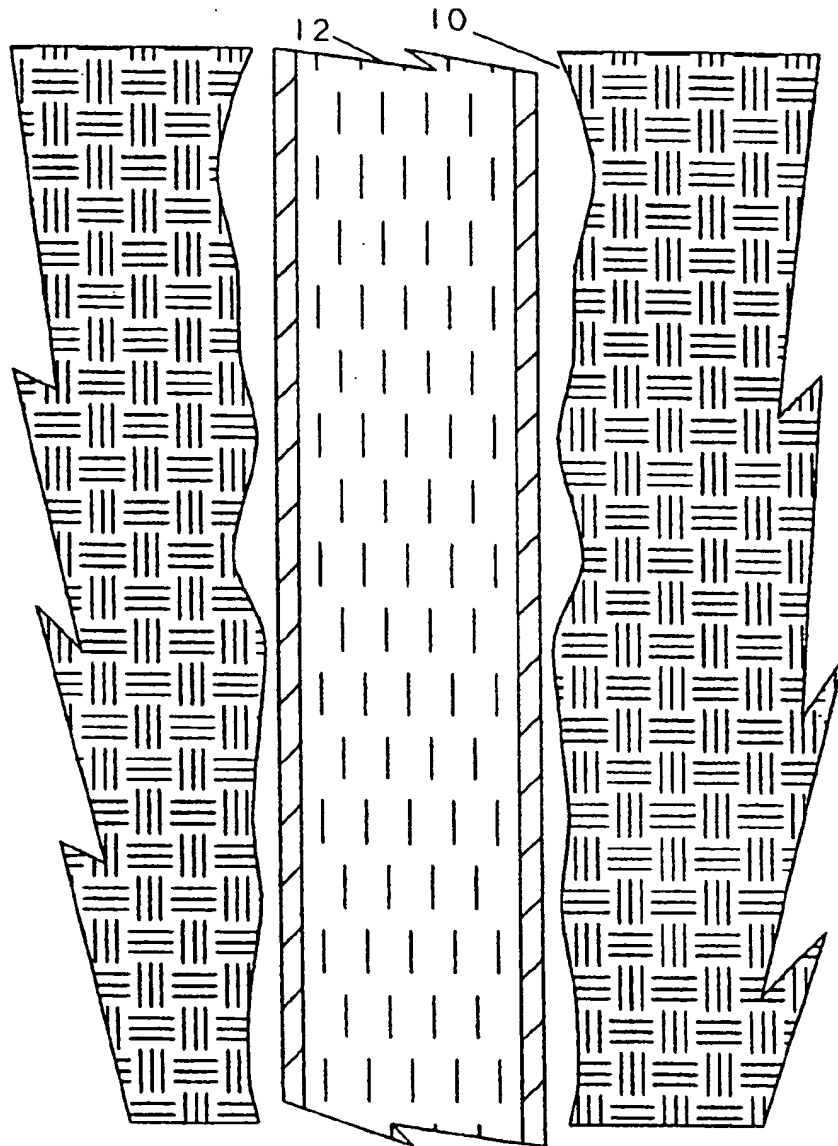


FIG. 1

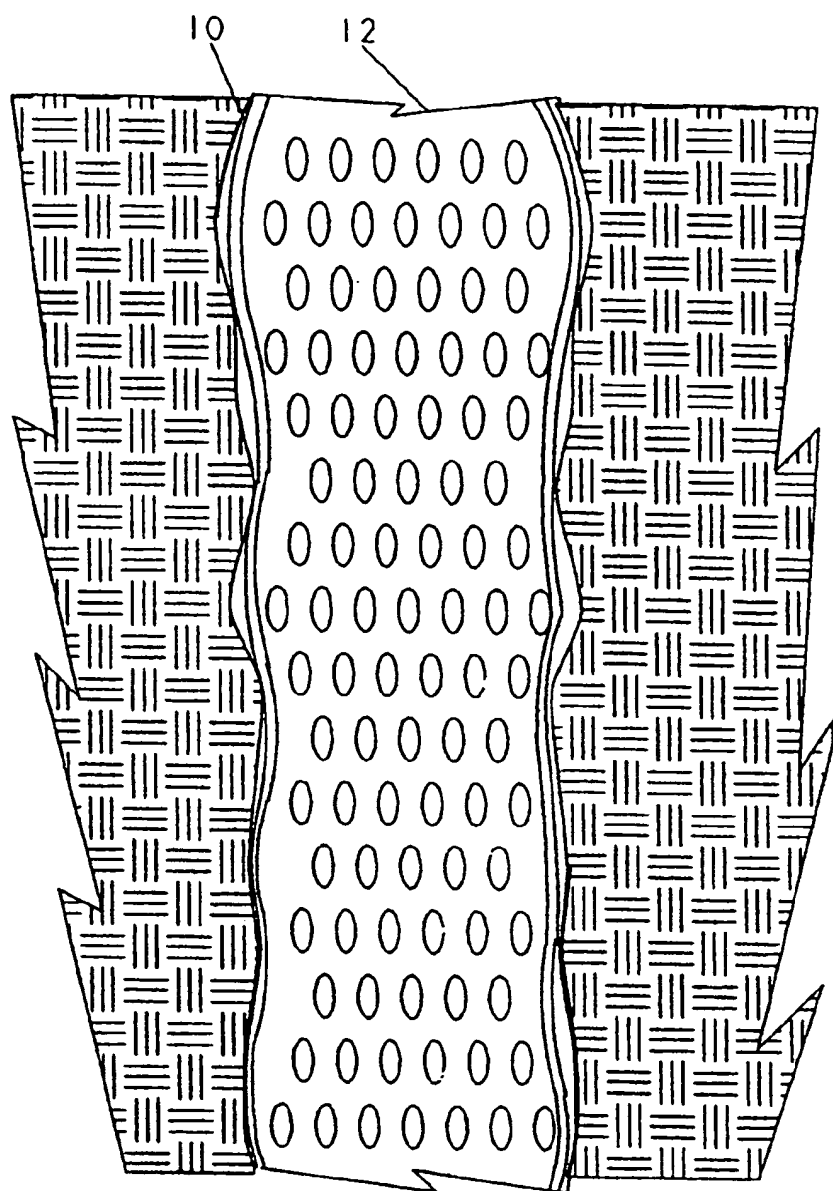


FIG. 2

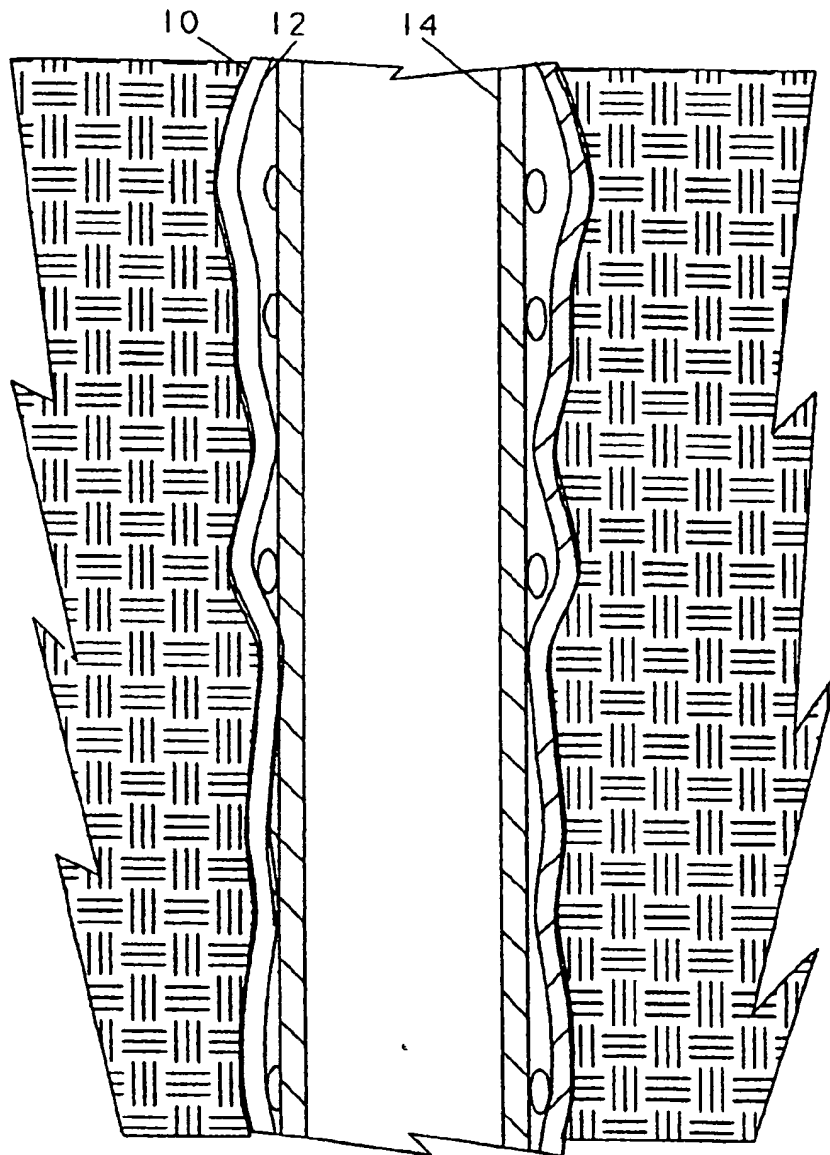


FIG. 3

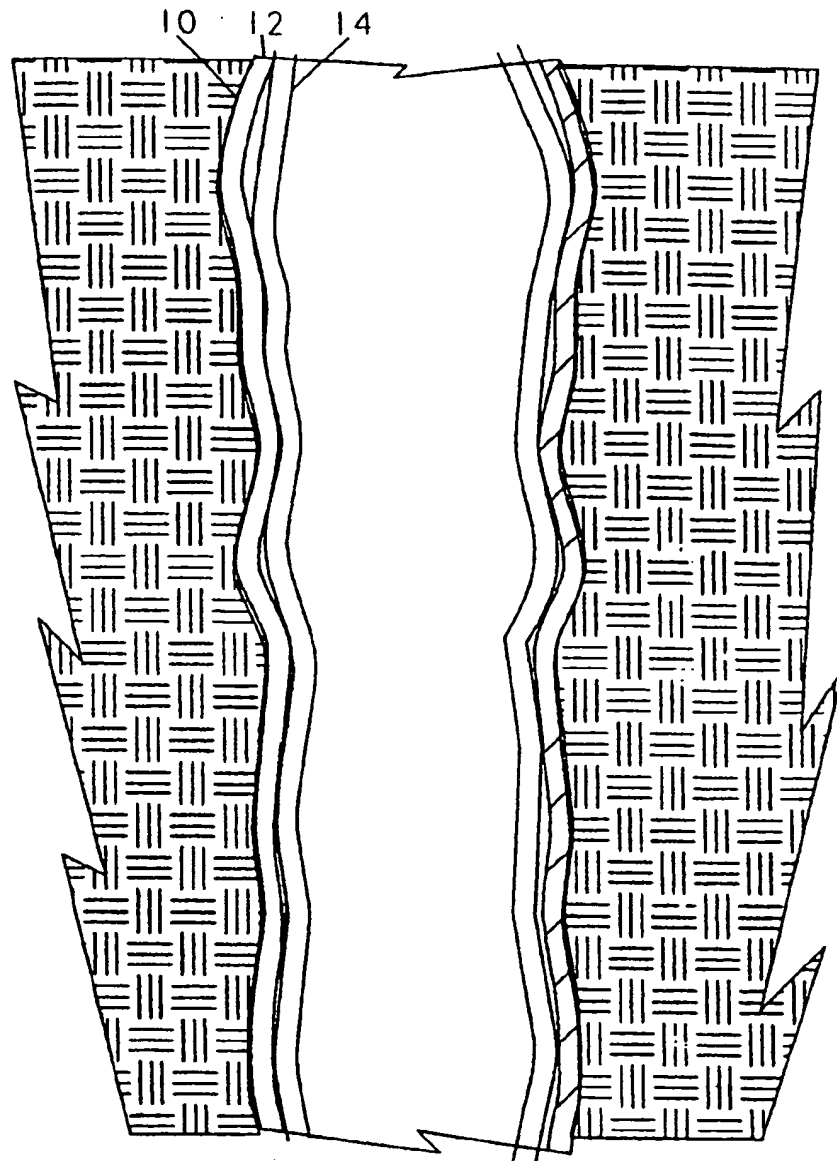


FIG. 4

INTERNATIONAL SEARCH REPORT

Intern. Appl. No.

PCT/US 00/04683

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B43/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 865 127 A (KOSTER CHARLES H) 12 September 1989 (1989-09-12) column 1, line 40 - line 55	1,9
A	US 4 872 509 A (DICKINSON BEN W O ET AL) 10 October 1989 (1989-10-10) column 4, line 68 -column 5, line 4 column 5, line 66 -column 6, line 8	1,9
A	US 3 918 520 A (HUTCHISON STANLEY O) 11 November 1975 (1975-11-11) abstract	1,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"S" document member of the same patent family

Date of the actual completion of the international search

6 June 2000

Date of mailing of the international search report

14/06/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tlx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Garrido Garcia, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Appl. No.

PCT/US 00/04683

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4865127	A	12-09-1989	AU 2942389 A	11-08-1989
			CA 1310261 A	17-11-1992
			EP 0357711 A	14-03-1990
			NO 893597 A	07-09-1989
			WO 8906738 A	27-07-1989
US 4872509	A	10-10-1989	US 4750561 A	14-06-1988
			AU 605122 B	10-01-1991
			AU 6673286 A	25-06-1987
			BR 8606305 A	06-10-1987
			CA 1297782 A	24-03-1992
			DE 3686478 A	24-09-1992
			DE 3686478 T	21-01-1993
			EP 0227456 A	01-07-1987
			MX 160919 A	19-06-1990
			US 4865128 A	12-09-1989
			US 5035285 A	30-07-1991
US 3918520	A	11-11-1975	AU 502025 B	12-07-1979
			AU 8531975 A	07-04-1977
			CA 1034489 A	11-07-1978
			NL 7511520 A	01-04-1976
			NO 753294 A,B,	31-03-1976
			US 3960212 A	01-06-1976

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☒ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER: _____**

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.